The average area under wheat in the United Kingdom during the years 1910, 1911, and 1912, was 1,926,040 acres, and the average yield was 59,436,392 bushels; while in the Commonwealth for the same period the area under wheat was 7,379,980 acres and the average yield 86,243,133 bushels, a difference in the total yield in favor of Australia of 26,806,741 bushels. In Australia wheat growing, under ordinary conditions, is generally considered a safe and payable proposition when 10 inches of rain and over falls from the month of April to that of October, inclusive. There are in all 484,330 square miles of country with 10 inches of rainfall and over during the wheat-growing period. The output of wheat has been steadily increasing from year to year, and there are vast possibilities of future development in this direction.

The climatic history and prosperity of the last 10 years or so contradict emphatically the preconceived notion that Australia is the particular drought-stricken and precarious area of the earth's surface. These misconceptions of the true character of the country have been held in the developmental stages, to a greater or less extent, in the early histories in the majority of all lands and in the colonization of newly discovered territories; e. g., see history of colonization of United States of America and early Egyptian history. The truth of the matter about Australia's rainfall is that—

(1) It is generally ample for pastoral and agricultural industries over two-thirds of its area.

(2) That different regions have distinct wet and dry periods; these must be fully recognized and industrial operations adapted accordingly.

(3) It is subject in part, but never in the whole, to prolonged periods when the rainfall is short of the seasonal average. Australia is not peculiar in this respect.

It follows, therefore, that, as the so far undeveloped country becomes populated and put to profitable use, the general wealth of the community as a whole will steadily increase.

A model representing the relative rainfall over Australia has been constructed at the Commonwealth Weather Bureau, on a horizontal scale of 133 miles to 1 inch and a vertical scale of 10 inches to 1 centimeter. This model shows at a glance how the annual rainfall is distributed, from the small precipitation over the far interior to the fringe of high rainfall around the greater portion of the coast line, culminating on the eastern side in a great "peak" indicating the annual precipitation over the Harvey Creek and Innisfail district resulting from the prevailing southeast trade winds carrying the moisture against the mountain ranges just inside the coast.

The fringe of relatively high rainfall along the eastern and southeastern coasts of the continent as the result of the elevated contours near the coast in those regions is also striking. The effect of the monsoonal rains over northern Australia is very apparent from the model, which shows the gradual increase of rainfall from less than 10 inches in the interior to over 60 inches on the north coast.

The manner in which the prevailing westerly trade winds carry moisture along the southerly portion of the Commonwealth is clearly marked by the elevations indicating the good rains received over the southwest corner of Australia, and further eastward how the ranges east of Adelaide cause good rainfall there and prevent the rain from that direction reaching the inland parts of Victoria.

In Tasmania, also, is seen the effect of the frequency of the moist westerly winds, causing high rainfall along the mountain ranges of the west coast, with resulting comparative dryness in the eastern parts of that State.

It may be of interest to note in closing that there exists apparently an oscillatory movement of the seasonal rains throughout Australia, about a center in the vicinity of Forbes, New South Wales. It is perhaps a natural coincidence that this apparent center of oscillation is approximately the center of gravity of the Commonwealth's population and is not far from the Federal capital site.

This peculiar oscillatory character of the monthly march of rainfall suggested the construction of a "rain clock." In the center of a piece of cardboard a map of Australia is cut out with a die. At the back of this another piece of cardboard representing the rain area is manipulated on a swivel. By moving the second piece of cardboard backward and forward with an amplitude of oscillation of one-fifth of a circle (72° arc) the land area of the continent affected by dry or wet conditions at any time of year is approximately indicated.

The immediate lessons to be learned from a study of this "clock" are that the seasonal rains are more regular than was generally believed, and that the alternating dry and wet seasons are definitely defined. That being so, when, in obedience to physical law, there is an absence of rain during the normally dry period in any part of Australia, such dryness should not be regarded as drought and an evil, but rather as nature's wise provision for resting the soil.

INFLUENCE OF WEATHER CONDITIONS ON THE AMOUNTS OF NITRIC ACID AND OF NITROUS ACID IN THE RAINFALL NEAR MELBOURNE, AUSTRALIA.[1]

By V. G. ANDERSON.

Daily determinations of the amounts of nitric and of nitrous acid in the rainfall at Canterbury, near Melbourne, have been made since November 1, 1912. The results to February 28, 1914, when correlated with meteorological data for Melbourne and daily isobaric charts of Australia, reveal the existence of a relation between weather conditions and the amounts of nitrogen acids in rain water.

The concentration of nitric acid reached a maximum in summer, a minimum in winter, and an intermediate position during autumn and spring.

The concentration of nitrous acid reached a maximum in winter and a minimum in summer. The ratio of nitric nitrogen to nitreous nitrogen was highest in summer and lowest in winter. On many occasions during winter the ratio was approximately 1:1. A relation between atmospheric temperature and this ratio was noted. Its nature was shown by plotting the mean minimum temperature each month with the mean monthly ratios, the curve being of the same type as those which express changes of chemical velocity with temperature. The ratio is doubled for equal increments of temperature. From the results it would appear that in rain water nitric and nitrous acids are formed in equal molecular proportions and that, if the ratio could be determined instantly or before any change could ensue, it would invariably be 1:1. In cold weather the velocity is retarded to such an extent that little change occurs even after comparatively long periods; hence the increased amounts of nitrous acid found in winter. In hot weather the velocity being greatly increased, the residual amounts of nitrous acid are very small, nearly all having been converted into nitric acid.

The facts point to atmospheric nitrogen peroxide as the source of nitric and nitrous acids in rain water, as

[1] *Reprinted from* Report of the Eighty-fourth Meeting, B. A. A. S., Australia, 1914. London, 1915, pp. 338-339.

this gas reacts with water, forming these acids in equal molecular proportions.

In a graph platted with daily concentrations of total nitrogen (nitric-nitrous) as abscissæ and with rainfall as ordinates, the points are found to arrange themselves into a series of rectangular hyperbolæ. Further, each group of points lying along a particular curve is found to correspond with falls of rain occurring during one particular type of weather. From this it follows that for a particular type of weather (1) the concentration of oxidized nitrogen varies inversely as the rainfall; (2) the product of the concentration and the rainfall is constant; (3) the total weight per unit area of oxidized nitrogen precipitated with rain falling during 24 hours is constant. In brief, the amount of oxidized nitrogen per acre carried down by rain falling on any day is a function of the type of weather and, within certain limits, is independent of the amount of rainfall. These facts may be explained by assuming that for each type of weather there exists in the air a definite concentration of nitrogen peroxide, and that this soluble gas is completely washed out of the air by the first portions of a shower; any further rain falling through the now purified air not increasing the amount of oxidized nitrogen in the rain water but decreasing, by dilution, the concentration.

Nine well-defined recurring types of [Australian] weather have been investigated. These may be classified into three groups as follows: (1) Antarctic types; (2) tropical types; (3) divided-control types (Antarctic and tropical). Table 1 presents the number of cases of each type investigated together with the oxidized nitrogen constant for each type.

TABLE 1.—*The oxidized nitrogen constant in rain accompanying different types of weather at Melbourne, Victoria, 1912–1914.*

Weather types.	Number.	Oxidized nitrogen constant.
Antarctic types:		*Lbs. per 1,000 acres.*
ʌ-shaped Antarctic depressions—		
(*a*) Rear	35	1.5
(*b*) Crest	28	2.5
(*c*) Front	10	4.1
Tropical types:		
Tropical (or monsoonal) depressions—		
(*g*) Spring and autumn	6	16.0
(*h*) Summer type	3	24.0
(*i*) "Heat-wave" type	2	35.0
Divided control types:		
(*d*) Antarctic depressions with *slight* tropical influence	6	6.1
(*e*) Antarctic depressions with *strong* tropical influence	4	8.5
(*f*) Tropical depressions with *slight* Antarctic influence	5	12.0

SERIAL NUMBERS OF WEATHER BUREAU PUBLICATIONS.

By ROBERT SEYBOTH, In Charge of Printing Division.

[Dated: U. S. Weather Bureau, Washington, August, 1915.]

Beginning with January, 1895, a serial number (e. g., W. B. 525) has been given to every Weather Bureau publication that has a full title page or cover.[1] This series includes all folio, quarto, and octavo bulletins, Instrument Division circulars, important miscellaneous publications and extracts from the MONTHLY WEATHER REVIEW, and the successive numbers of the MONTHLY WEATHER REVIEW. As it was found that 59 publications had been issued prior to 1895, counting from the date on which the Weather Bureau was organized by the transfer of the meteorological duties of the Signal Service of the Army to the Department of Agriculture, July 1, 1891, the first publication of 1895 was given the serial number 60. The 59 numbers above referred to do not include the numerous publications issued by the bureau (Signal Service) prior to its transfer from the War Department to the Department of Agriculture.

Most of the numbers from 60 to 210, inclusive, as well as some later ones, are no longer available for distribution.

The reader is particularly urged to note carefully that the symbol "W. B. No. 545" refers to the *serial number* in the following list; it does *not* mean "Weather Bureau Bulletin No. 545," and should not be referred to as such.

W. B. No.	Title of publication.
60	Monthly Weather Review for January, 1895.
61	Instructions to Observers, and Code for Enciphering Reports at Cotton Region and Sugar and Rice Stations of the Weather Bureau.
62	Monthly Weather Review. Annual Summary for 1894.
63	Studies of Weather Types and Storms. No. 1. Types of Storms in January. Extract from Monthly Weather Review.
64	Monthly Weather Review for February, 1895.
65	Monthly Weather Review for March, 1895.
66	Circular B. Instructions for Use of Maximum and Minimum Thermometers. C. F. Marvin. Revised edition.
67	Circular C. Instructions for Use of the Rain Gauge. C. F. Marvin. Revised edition.
68	Monthly Weather Review for April, 1895.
69	Climate and Health. No. 1.
70	Monthly Weather Review for May, 1895.
71	Climate and Health. No. 2.
72	Monthly Weather Review for June, 1895.
73	Climate and Health. No. 3.
74	Monthly Weather Review for July, 1895.
75	Climate and Health. No. 4.
76	Monthly Weather Review for August, 1895.
77	Bulletin No. 16. The Determination of the Relative Quantities of Aqueous Vapor in the Atmosphere by means of the Absorption Lines of the Spectrum. L. E. Jewell.
78	Climate and Health. No. 5.
79	Monthly Weather Review for September, 1895.
80	Instructions to Wind-Signal (Storm-Warning) Displaymen of the Weather Bureau.
81	Statistics of the State Weather Services. O. L. Fassig. *Extract from* Monthly Weather Review.
82	Climate and Health. No. 6.
83	Monthly Weather Review for October, 1895.
84	Climate and Health, Vol. 2, No. 1.
85	Departures from Normal Temperatures and Rainfall, with Crop Yields in Nebraska. H. H. C. Dunwoody.
86	Injury from Frost and Methods of Protection. H. E. Williams.
87	Display of Wind Signals on the Great Lakes.
88	Bulletin No. 17. The Work of the Weather Bureau in Connection with the Rivers of the United States. Willis L. Moore.
89	Monthly Weather Review for November, 1895.
90	Bulletin No. 18. Report of the Fourth Annual Meeting of the American Association of State Weather Services, held at Indianapolis, Indiana, October 16 and 17, 1895. James Berry.
91	Monthly Weather Review for December, 1895.
92	Studies of Weather Types and Storms. Part 2. E. B. Garriott and others. *Extract from* Monthly Weather Review.
93	Climate and Health. Vol. 2, No. 2.
94	Monthly Weather Review. Annual Summary for 1895.
95	Monthly Weather Review for January, 1896.
96	Climate and Health. Vol. 2, No. 3.
97	Bulletin No. 19. Report on the Relative Humidity of Southern New England and other Localities. A. J. Henry.
98	Monthly Weather Review for February, 1896.
99	Monthly Weather Review for March, 1896.
100	Bulletin No. 13. Temperatures Injurious to Food Products in Storage and During Transportation, and Methods of Protection from the Same. H. E. Williams. Reprinted as Farmers' Bulletin No. 125.
101	Monthly Weather Review for April, 1896.
102	St. Louis Tornado. H. C. Frankenfield and A. J. Henry. *Extract from* Monthly Weather Review.
103	Monthly Weather Review for May, 1896.
104	Responses to the Programme of Questions Proposed for Discussion at the International Meteorological Conference to be held in Paris September, 1896.
105	Monthly Weather Review for June, 1896.
106	Monthly Weather Review for July, 1896.

[1] See MONTHLY WEATHER REVIEW, November, 1902, 30: 528–530.